

Blockchain in Telecommunications

Matthew N. O. Sadiku¹, Paul A. Adekunle², Janet O. Sadiku³

¹Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA

²International Institute of Professional Security, Lagos, Nigeria

³Juliana King University, Houston, TX, USA

ABSTRACT

Blockchain is a decentralized peer-to-peer distributed network ledger and the architecture of a new Internet. Blockchain technology has transcended its origins in cryptocurrency to become a pivotal player in the telecommunications sector. It is a game-changer in the telecom industry. Its integration with telecom introduces unparalleled security, transparency, and efficiency, revolutionizing network operations. The integration also represents a significant shift towards more secure, efficient, and transparent operations. In this paper, we will explore the potential of blockchain in the telecommunications industry.

KEYWORDS: *blockchain, telecommunications industry, integration*

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INTRODUCTION

Recently, modern technologies have aided business titans in deciding to use digital currency rather than conventional trade in order to avoid fraud. Blockchain is a shared ledger that is replicated across users in a particular network. It enables the existence of Bitcoin and many other cryptocurrencies. We all associate blockchain with Bitcoins. A cryptocurrency refers to a digital asset that works as a medium of exchange between various business organizations. Blockchain technology has gained significant popularity in various industries, including finance, healthcare, and supply chain management. Figure 1 shows the symbol of blockchain [1].

Originally synonymous with cryptocurrencies, blockchain has transcended its financial roots to permeate various industries, promising enhanced security, transparency, and efficiency. Among these sectors, the telecommunications industry stands on the cusp of profound transformation. The telecommunications industry, which is responsible for connecting people and devices globally, can also benefit greatly from blockchain technology. The

industry is noted for its complexity, as shown in Figure 2 [2]. Telecom industry today has the most complex operations framework, involving many partners, vendors, customers, distributors, network providers, and VAS providers. The acceptance of blockchain in telecom is a requirement in the digital era. Its transformative potential is reshaping the industry, promising a future of enhanced connectivity and seamless operations. By adopting blockchain technology, companies like China Mobile, Deutsche Telekom, SK Telecom, Telstra, and Vodafone prioritize your security, transparency, and overall satisfaction.

WHAT IS BLOCKCHAIN?

Blockchain, a type of distributed digital ledger technology (DLT), is a relatively new and exciting way of recording transactions in the digital age. It is a decentralized and distributed digital ledger technology that securely records and verifies transactions across multiple computers or nodes in a network. Basically, it is a chain of blocks in which each block contains a list of transactions.

The blockchain technology was created as the foundational basis for Bitcoin – a digital currency in which secure peer-to-peer transactions occur over the Internet. It is expected that the spending on blockchain solutions worldwide would grow from 4.5 billion USD (2020) to an estimated value of 19 billion USD by 2024 [3].

Originally developed as the accounting method for the virtual currency Bitcoin, Blockchains are appearing in a variety of commercial applications today. Blockchain technology is a type of distributed digital ledger that uses encryption to make entries permanent and tamper-proof and can be programmed to record financial transactions. It is used for secure transfer of money, assets, and information via a computer network such as the Internet without requiring a third-party intermediary. It is now being adopted across financial and non-financial sectors. As a catalyst for change, the Blockchain technology is going to change the business world and financial matters in major ways.

The first Blockchain was conceived in 2008 by an anonymous person or group known as Satoshi Nakamoto, who published a white paper introducing the concept of a peer-to-peer electronic cash system he called Bitcoin [4,5]. Bitcoin and Ethereum are the first two mainstream blockchains. Other modern blockchains include Namecoin, Peercoin, Ether, and Litecoin. Figure 3 shows different components of blockchain [6].

Blockchain combines existing technologies such as distributed digital ledgers, encryption, immutable records management, asset tokenization and decentralized governance to capture and record information that participants in a network need to interact and transact. As illustrated in Figure 4, a complete blockchain incorporates all the following five elements [7]:

- *Distribution:* Digital assets are distributed, not copied or transferred. A protocol establishes a set of rules in the form of distributed mathematical computations that ensures the integrity of the data exchanged among a large number of computing devices without going through a trusted third party. A centralized architecture presents several issues including a single point of failure and problems of scalability.
- *Encryption:* BC uses technologies such as public and private keys to record data securely and semi-anonymously. Completed transactions are cryptographically signed, time-stamped, and sequentially added to the ledger.
- *Immutability:* The Blockchain was designed so these transactions are immutable, i.e. they cannot

be deleted. No entity can modify the transaction records. Thus, Blockchains are secure and meddle-free by design. Data can be distributed, but not copied.

- *Tokenization:* Value is exchanged in the form of tokens, which can represent a wide variety of asset types, including monetary assets, units of data or user identities.
- *Decentralization:* No single entity controls a majority of the nodes or dictates the rules. A consensus mechanism verifies and approves transactions, eliminating the need for a central intermediary to govern the network.

Bitcoin and its underlying blockchain technology increasingly impact all facets of society. Bitcoin's status as digital gold is merely the tip of this technology. Figure 5 shows Bitcoin [8]. Although blockchain technology will for all time be associated with Bitcoin due to their common genesis, it has broader applications. Cryptocurrency will increasingly become a factor in family law issues as well.

In a nutshell, blockchain technology involves three basic concepts [9]: (1) It is a system for recording a series of data items (such as transactions between parties); (2) It uses cryptography to make it difficult to tamper with past entries; (3) It has an agreed process for storing copies of the ledger and adding new entries (also called a consensus protocol).

BLOCK CHAIN IN TELECOMMUNICATIONS

Blockchain technology, at its core, is a decentralized digital ledger that records transactions across multiple computers in such a way that the registered transactions cannot be altered retroactively. Blockchain in telecommunications refers to integrating blockchain technology within the telecom industry. It means using unique technology to make telecom networks safer and more efficient. It involves utilizing blockchain's distributed ledger technology to optimize processes, transactions, and security measures within the telecom sector. Figure 6 shows blockchain in telecommunications [10].

The telecommunications industry plays a pivotal role in global connectivity, and the adoption of blockchain technology has become increasingly relevant due to its potential to address various challenges and provide innovative solutions. Blockchain is being explored by all major industries, including the telecom sector, to determine its benefits and how to apply it to its operations. The integration of blockchain technology in the telecom sector presents numerous opportunities for creating new revenue streams while addressing existing operational challenges. There are many

reasons to use blockchain in the telecommunications industry. The telecom sector is suffering from several shortcomings. Blockchain can benefit the telecom industry in overcoming these shortcomings. It has a lot to offer and is ready to deliver results and transform the telecom industry for good. It has the potential to enhance security and create additional sources of income for telecom enterprises. Adopting blockchain is worth the cost.

APPLICATION OF BLOCK CHAIN IN TELECOMMUNICATIONS

Blockchain, which started as the underlying technology for the digital currency Bitcoin, has since expanded to include real estate, finance, education, retail, telecom, and other industries. In the telecom sector, blockchain is already being leveraged to enhance various aspects of operations. Blockchain in telecommunications encompasses various applications that revolutionize the industry, promising enhanced efficiency, security, and transparency. The following applications demonstrate the different ways that telecom industry can invest in the development and implementation of blockchain-based products [11-13]:

- *Decentralized Networks:* Blockchain technology can be used to create a decentralized network for telecommunications providers, which can help to reduce infrastructure costs and improve the speed and reliability of data transfer. The core solution of the telecom problem can be solved by decentralization, which is one of the core features of the blockchain method. Telecom, through blockchain, creates decentralized networks, reducing reliance on central authorities for operations. You benefit from a more resilient, transparent network structure, enhancing reliability and trust in communication.
- *Smart Contracts:* Smart contracts, being self-executing, are programmed in a way that they can verify that the terms of the contract have been met and then execute the terms without the need of an intermediary or central authority. Smart contracts, embedded within the blockchain, ensure the integrity of operator transactions while encrypting customer information to prevent tampering. Through blockchain platforms in telecommunications, smart contracts automate and secure agreements. With blockchain technology, telecom providers can create smart contracts that are executed without human intervention, making for a seamless automated experience. You reorganize contract execution, ensuring transparency and reducing transactional disputes. By using blockchain, smart contracts can automate process and guarantee the settlement between the participants, by routing from one operator's blockchain to another operator and increase transparency to the end customer. A telecom provider utilizes smart contracts to automate billing processes for international roaming services.
- *Supply Chain Management:* Telecom operators rely on a complex supply chain to deliver their services, including hardware, software, and third-party services. Blockchain in telecom facilitates and transforms supply chain management. It will enhance transparency and traceability. Moreover, you will track product journeys seamlessly, reducing fraud possibilities and ensuring authentic transactions. Integration of blockchain will simplify supply chain operations, optimizing efficiency and reliability. AT&T is utilizing blockchain to automate and transform their supply chain processes that impact their products – handsets and network equipment.
- *Fraud Prevention:* This is another use case that telcos are depending on blockchain to help cater to. Telecom companies face challenges related to billing accuracy and fraud prevention. They significantly suffer from fraudulent schemes each year. Telecom networks are vulnerable to cyber-attacks and fraud, leading to financial losses and reputational damage. Blockchain can enhance the security of telecom networks by providing a tamper-proof record of all network activities. Using blockchain we can look at significantly decrease the cost of fraud in roaming and in identity management.
- *Billing and Settlement:* Blockchain technology automates critical telecom operations, including billing and roaming. Blockchain modernizes billing processes, ensuring transparent, accurate, and timely payments within the telecom sector. Blockchain technology can be used to create a more efficient and transparent billing and settlement system for telecommunications providers. By using blockchain technology, telecommunications providers can reduce costs and improve the accuracy and speed of billing and settlement processes.
- *Mobile Payment Solutions:* Blockchain technology can be used to create mobile payment solutions that are more secure and efficient than traditional payment methods. By using blockchain technology, telecommunications providers can offer customers a more secure way to make payments and transfer funds. Blockchain for telecommunications revolutionizes mobile

payment solutions, enabling secure and efficient transactions. Your mobile transactions become faster, more transparent, and resistant to fraud or manipulation. Telecom enterprises can use blockchain to enable micropayments for music, mobile games, and other services.

- *IoT Connectivity:* Within the next decade, there will be billions of IoT cellular connections. With IoT connections growing exponentially over time, data insecurity will increase simultaneously. Blockchain technology can be used to create a more secure and efficient network for the Internet of things (IoT) devices. By using blockchain technology, telecommunications providers can offer customers a more secure and reliable way to connect their IoT devices to the Internet. Blockchain for telecommunications empowers IoT connectivity in telecom, enhancing the reliability and security of interconnected devices. You experience seamless, trustworthy communication among your IoT devices.
- *Identity Management:* One of the clearest cases of blockchain applications for telecom is identity management. Blockchain can facilitate user-controlled identity management. Users can have control over their personal information, allowing them to share specific data with service providers while maintaining privacy. Currently, when customers register for new accounts, they have to go through a cumbersome “Know Your Customer” (KYC) process which involves handing over or uploading sensitive information. Integrating blockchain with your existing telecom networks can remove this hazard as customer identities are no longer stored with a centralized third-party but in a decentralized, tamper-proof immutable ledger, with no single point of failure. This revolutionary technology gives rise to a blockchain identity management use case (identity-as-a-service).
- *5G Enablement:* 5G is another technology that can benefit from blockchain. The demand for communication services is increasing, and the world is switching to a 5G network, which is ten times faster than 4G. Managing such a complex network will require a greater calculation power and storage capacity. 5G promises prevalent access to various networks, and telecom entrepreneurs will need to handle versatile access nodes. Choosing the fastest access node for every user will soon become a significant challenge for telecom companies. Blockchain has the potential to enable such access selection mechanisms when 5G is developed. It can create highly protected

peer-to-peer self-managed mesh networks that use an extensive number of nodes.

- *Operations Advancement:* Currently, the transactions in telecom ledgers need to go through a clearinghouse to be approved. Smart contracts automatically provide the settlement between the participants by routing from one operator's blockchain to another operator. It also increases transparency to the end customer.
- *Content Distribution:* With blockchain for the telecom industry, content distribution becomes more efficient and transparent. You can securely share and access content, ensuring authenticity and copyright protection.

Figure 7 shows some of the applications of blockchain in telecommunications [14].

BENEFITS

The integration of blockchain in telecommunications offers great benefits to telecom. It boosts security by protecting data from online threats, makes transactions faster and cheaper by cutting out middlemen, and ensures everything is transparent and accountable across the network. Other benefits include [12]:

- *Improved Connectivity:* Blockchain can improve connectivity by enabling direct transactions between telecom service providers and their customers. This means that customers can directly pay for the services they use. Blockchain in telecommunications offers enhanced connectivity by creating a decentralized network. You benefit from smoother communication channels, ensuring seamless interactions. With blockchain's distributed ledger system, information transmission becomes more efficient. Whether securing digital identities or managing supply chains, blockchain's integration reshapes telecom into a more efficient, secure, and interconnected ecosystem.
- *Increased Transparency:* There are a lot of trust issues and transparency challenges due to the involvement of multiple entities. Blockchain can increase transparency in telecommunications by providing an immutable and auditable record of all transactions. Blockchain technology in telecom provides heightened transparency within operations. You get a clear view of transaction histories and data exchanges. Through its immutable ledger, every transaction becomes traceable and verifiable. This can help to reduce fraud, improve compliance, and increase trust between telecom service providers and their customers.

- *Greater Security:* In telecom, security is paramount. Cyber security attacks have become a common phenomenon in every industry and the telecommunication industry is not immune to them either. One of the most significant advantages of blockchain in telecommunications is enhanced security. Blockchain technology ensures robust security, safeguarding sensitive data and transactions from cyber threats. Through its decentralized structure, blockchain offers an immutable ledger, minimizing the risk of data breaches. Blockchain helps manage data and transactions better, making systems more reliable and trustworthy. It employs advanced cryptographic techniques to safeguard data integrity. With its decentralized nature, blockchain diminishes vulnerabilities associated with centralized systems.
- *Enhanced Privacy:* Data privacy has been a trending issue for some time now. Awareness among consumers as well as regulators has been increasing about the significance of consumer data. Blockchain technology is safe and robust. It is ideal for storing and processing sensitive information. Blockchain encrypts data and enables users to control their information. It enhances privacy and minimizes the unauthorized access risk.
- *Enhanced Customer Experience:* Through blockchain in telecom, customer experiences are enriched. Transactions become more seamless, empowering users with increased control and transparency over their data and services. Blockchain platforms in telecommunications revolutionize customer experiences by optimizing services. You can enjoy improved service quality and personalized offerings. Through efficient data management, telecom providers modify solutions to your specific needs.
- *Cost Savings:* Blockchain can help telecom service providers to reduce costs by eliminating intermediaries and automating processes. This can help to reduce overheads and improve the efficiency of transactions. Blockchain in telecom enables significant cost savings through restructured processes. By eliminating intermediaries, transactions become more efficient and cost-effective. Smart contracts automate tasks, reducing manual intervention and associated expenses.
- *Improved Interoperability:* Blockchain can improve interoperability between different telecom service providers by creating a decentralized and standardized network.
- Blockchain technology fosters improved interoperability among telecom systems and devices. It facilitates seamless integration between different networks and platforms. This interoperability enhances communication and data exchange between various stakeholders.
- *Secure Payments:* Blockchain development in telecommunications will ensure secure payments by eliminating intermediaries. You will experience faster, tamper-proof transactions, bolstering trust and reducing fraud risks. Implementing blockchain technology will enhance payment security, streamlining financial processes within the telecom industry.
- *Global Roaming:* At the moment, roaming agreements between telecom operators are complex and require intermediaries to facilitate transactions. With blockchain in telecommunications, global roaming will become easier and transparent. You will experience enhanced connectivity across diverse networks. Moreover, it will reduce complexities and costs associated with roaming. Blockchain will surely facilitate smoother transactions, ensuring better service availability worldwide.
- *Lowering Operational Costs:* Telecommunications operators have long grappled with shrinking margins amidst technological advancements and shifting consumer behaviors. The digitization and virtualization of services have necessitated a reevaluation of operational strategies, with blockchain emerging as a cost-effective solution. The elimination of physical SIM cards and associated distribution costs signifies a symbolic shift towards efficiency and fraud prevention.
- *Quality of Service (QoS):* Blockchain can be used to monitor and verify quality of service metrics, ensuring that customers receive the promised levels of service quality. This is particularly important as 5G technology and the Internet of things (IoT) continue to expand.
- *Enhanced Efficiency:* By leveraging smart contracts and automation, blockchain can streamline and optimize various processes involved in international financial transactions. A blockchain-enhanced approach for telecom payment and invoicing offers several advantages over current market norms. It enables interoperability, allowing seamless transactions between different carriers or payment platforms without intermediaries. The use of smart contracts automates processes, increasing efficiency and

reducing costs. Blockchain technology improves trust, efficiency, transparency, and security in telecom payment and invoicing systems.

Some of these benefits/advantages are displayed in Figure 8 [12].

CHALLENGES

While blockchain brings numerous benefits, challenges exist. Blockchain for telecommunications encounters challenges that necessitate careful consideration and strategic planning. Scalability and interoperability concerns need addressing to ensure seamless integration and widespread adoption across the telecom network. Overcoming integration hurdles, ensuring scalability, complying with regulations, fortifying security, and managing costs are pivotal for successful implementation. Both providers and subscribers struggle with roaming, high fees, risk of fraud, privacy issues, and so much more. Other challenges include the following [12,13]:

- *Integration:* Integrating blockchain for telecommunications poses challenges due to its complex nature. You will need expertise and resources for seamless integration into existing systems. Ensuring compatibility between blockchain and current telecom infrastructure demands careful planning and execution.
- *Scalability:* One of the main challenges of blockchain in telecommunications is its limited scalability. As network demands grow, ensuring blockchain can handle increased transactions and data becomes crucial. One will need scalable solutions that accommodate the expanding network without compromising efficiency.
- *Regulatory Compliance:* Telecommunications companies operate in a heavily regulated environment, and implementing blockchain technology may require them to navigate complex regulatory frameworks. Meeting regulatory requirements poses a challenge for blockchain in telecom. Adhering to evolving legal frameworks while maintaining blockchain's decentralized nature can be intricate and challenging. You must go through complex compliance standards across different regions, ensuring data privacy and security measures align with regulatory mandates.
- *Security:* Although the blockchain platform is renowned for its security, challenges persist within the telecom sector. Safeguarding against sophisticated cyber threats requires constant vigilance and innovation. You will need robust encryption methods and consensus mechanisms to protect sensitive data.

➤ *Cost:* Implementing blockchain in telecommunications can incur substantial costs. Developing and maintaining blockchain networks demands significant technological, expertise, and infrastructure investments. Upgrading existing systems and training personnel adds to the expenses.

➤ *Combatting Fraud:* Fraud remains a persistent challenge in the telecommunications sector, particularly concerning roaming services. Through peer-to-peer roaming data exchanges, telecom operators can enhance security measures while minimizing the resources dedicated to fraud detection and prevention.

Some of these challenges are displayed in Figure 9 [12].

CONCLUSION

Although blockchain technology is relatively new to the telecommunications industry, it has the potential of revolutionizing telecommunications in the future. Blockchain is changing how telecom works, offering better security, efficiency, and trust. We are looking at a future where we reduce dependency on traditional centralized software/ operators to provide an authentication mechanism. As the industry undergoes rapid digital transformation, blockchain emerges as a catalyst for innovation, offering solutions to longstanding challenges and unlocking new opportunities for growth and efficiency.

As the need for secure communication grows, picking blockchain for telecom is crucial. It means committing to a safer, faster, and more customer-focused telecom world. The future of blockchain in telecommunications is promising, offering transformative solutions to various industry challenges. Blockchain technology will enable secure and efficient payment systems. More information on the integration of blockchain technology into telecommunications is available from the books in [15-18].

REFERENCES

- [1] "Blockchain meets the oil & gas industry," February 2018, <https://executiveacademy.at/en/news/detail/blockchain-meets-the-oil-gas-industry/>
- [2] S. Chauhan, "Blockchain applications in the telecommunications sector, May 2021, <https://www.linkedin.com/pulse/blockchain-applications-telecommunications-sector-suman-chauhan/>
- [3] C. M. M. Kotteti and M. N. O. Sadiku, "Blockchain technology," *International*

Journal of Trend in Research and Development, vol. 10, no. 3, May-June 2023, pp. 274-276.

- [4] "Blockchain," *Wikipedia*, the free encyclopedia <https://en.wikipedia.org/wiki/Blockchain>
- [5] S. Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," <https://bitcoin.org/bitcoin.pdf>
- [6] "The beginning of a new era in technology: Blockchain traceability," <https://www.visiott.com/blog/blockchain-traceability/#:~:text=The%20Beginning%20of%20a%20New,money%20without%20a%20central%20bank.>
- [7] "The CIO's guide to blockchain," <https://www.gartner.com/smarterwithgartner/the-cios-guide-to-blockchain#:~:text=True%20blockchain%20has%20five%20elements,%2C%20immutability%2C%20tokenization%20and%20decentralization.>
- [8] "Blockchain and space exploration: Is decentralized data the future of space missions?" October 2024, <https://medium.com/coinmonks/is-decentralized-data-the-future-of-space-missions-646173d1aeec>
- [9] D. Michels, "Technology blockchain and telecoms," chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/ <https://www.iicom.org/wp-content/uploads/22-26-blockchain.pdf>
- [10] K. Leslove, "Do telecom firms need to focus on blockchain integration?" December 2022, [https://media.hashcashconsultants.com/do-](https://media.hashcashconsultants.com/do-telecom-firms-need-to-focus-on-blockchain-integration/)
- [11] "Top 5 blockchain use cases in telecom," <https://www.protokol.com/insights/top-5-blockchain-use-cases-in-telecom/>
- [12] "Blockchain for telecommunications: Innovative industry solution," January 2024, <https://webisoft.com/articles/blockchain-for-telecommunications/>
- [13] H. White, "5 Ways in which blockchain will revolutionise telecom industry," March 2024, <https://www.mobiliseglobal.com/five-ways-blockchain-will-change-telecoms-industry/>
- [14] "Blockchain Use Cases in the Telecom Industry," January 2023, <https://www.infopulse.com/blog/blockchain-use-cases-in-the-telecom-industry>
- [15] M. N. O. Sadiku, *Blockchain Technology and Its Applications*. Moldova, Europe: Lambert Academic Publishing, 2023.
- [16] M. Pustišek, N. Živić, and A. Kos, *Blockchain: Technology and Applications for Industry 4.0, Smart Energy, and Smart Cities (De Gruyter STEM)*. De Gruyter, 2021.
- [17] M. H. Rehmani, *Blockchain Systems and Communication Networks: From Concepts to Implementation (Textbooks in Telecommunication Engineering)*. Springer, 2021.
- [18] S. S. Biswas, *Blockchain in Telecom An Insight into the Potential Benefits of Combining Blockchain, 5G, IoT, Cloud Computing, and AI/ML in the Telecom Business (English Edition)*. Bpb Publications, 2021.

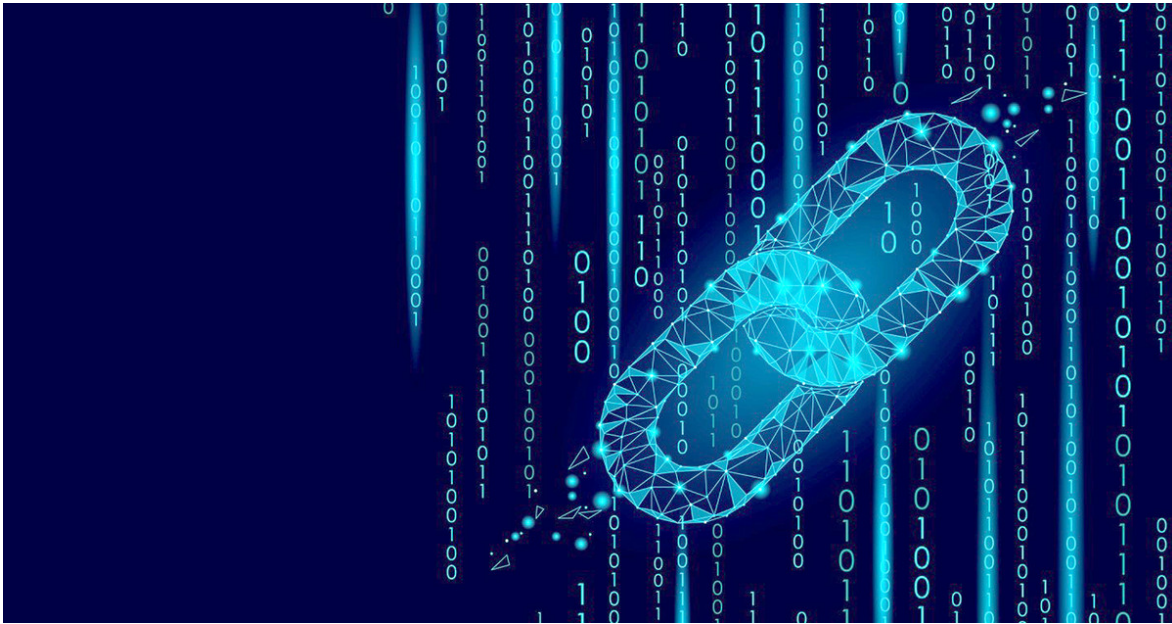


Figure 1 The symbol of blockchain [1].



Figure 2 The complexity of telecom infrastructure [2].

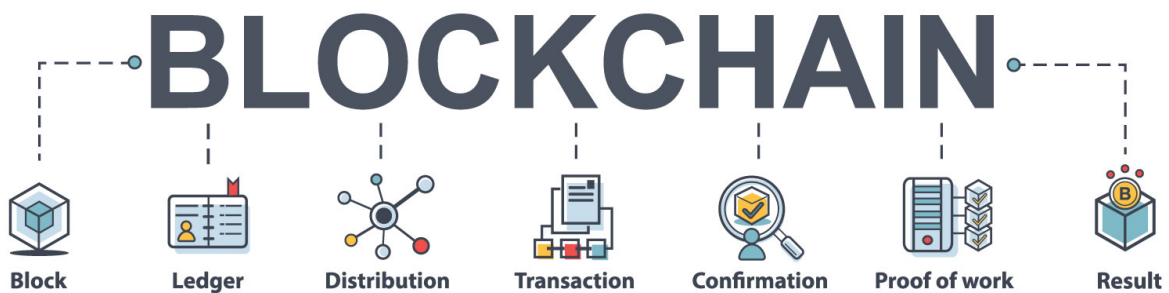


Figure 3 Different components of Blockchain [6].

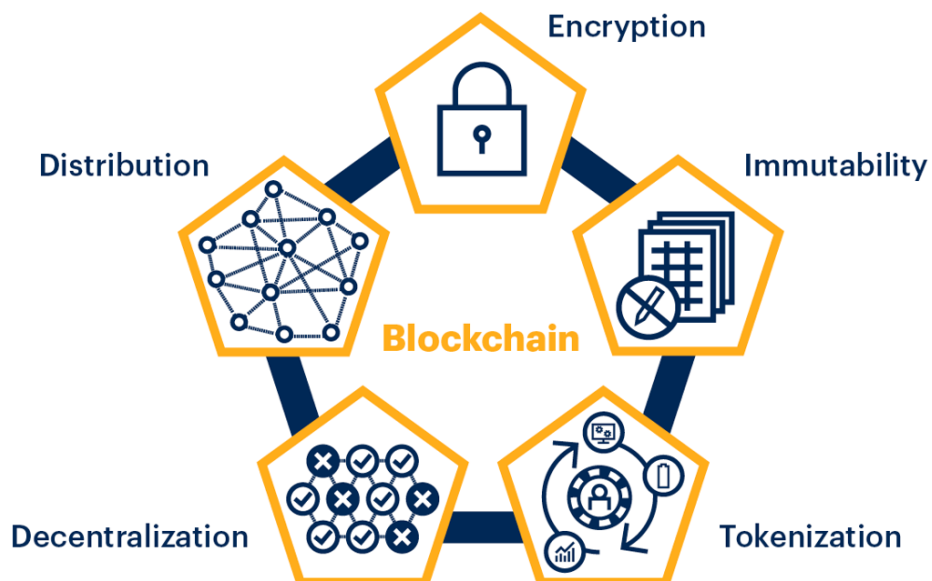


Figure 4 Five key elements of Blockchain [7].



Figure 5 Bitcoin [8].



Figure 6 Blockchain in telecommunications [10].



Figure 7 Some applications of blockchain in telecommunications [14].

Advantages of Blockchain in Telecommunications

- ◆ Improved Connectivity
- ◆ Increased Transparency
- ◆ Greater Security
- ◆ Enhanced Customer Experience
- ◆ Cost Savings
- ◆ Improved Interoperability

Figure 8 Some of the benefits/advantages of blockchain in telecom [12].

Challenges of Blockchain in Telecommunications

- Integration
- Scalability
- Regulatory Compliance
- Security
- Cost

Figure 9 Some of the challenges of blockchain in telecom [12].